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ARTICLE FROM CZECH PERIODICAL ANALYZES FULFILLMENT OF COST PLAN IN RAILROAD TRANSPORT

The information in this report is taken from extracts from a book by Orlov, Kalkulace vlastnich nakladu v zeleznicni doprave (Calculation of Costs in Railroad Transportation) -- presumably a Russian book originally -- which appeared in a supplement to the Czech periodical CZ /Cenove Zpravy?/

In the railroad transport field, as in any other sector of the /Soviet/ economy, it is not possible to evaluate total plan fulfillment merely by comparing actual and planned costs.

If volume of traffic has increased 10 percent over the amount planned, and costs increased 5 percent, this does not mean that the enterprise exceeded its cost plan.

The decrease or increase in costs as compared with the budget may indicate lowered or increased efficiency of operation, but it could also indicate lowered or increased volume of traffic. Therefore, to evaluate costs correctly, the budgetary amounts set aside for specific costs should be adjusted in direct ratio to actual volume, to give the proper basis for comparison as to fulfillment of the cost plan.

Thus, if the planned operational cost of a railroad for a planned 8,800,000,000 ton-kilometers is 452.6 million rubles and the actual cost is 470 million rubles for the 9,600/,000,000/ ton-kilometers actually traveled, it would be incorrect to state that the railroad exceeded its cost plan by 17.4 million rubles and that the cost per ton-kilometer was 0.0515 ruble or 5.15 kopecks. The 9,600,000,000 ton-kilometers actually traveled, multiplied by the planned cost of 5.15 kopecks per ton-kilometer, yield a total cost of 494 million rubles, while actual costs were 470 million rubles, a saving of 24 million rubles.

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This lowered operational cost can be stated in another way. The actual cost of 470 million rubles, divided by the 9,600,000,000 ton-kilometers traveled, results in 4.9 kopecks per ton-kilometer, which, compared with the planned cost of 5.15 kopecks per ton-kilometer, shows a saving of 0.25 kopeck per ton-kilometer.

However, to evaluate this saving in operational costs intelligently, it must be ascertained whether maintenance of locomotives was kept current and whether annual overhaul of passenger cars took place; in other words, whether the saving in operational costs is offset by lowered values of equipment or detriment to permanent installations, or whether it was effected entirely because repair work was omitted. Then, too, it is necessary to clarify the source of the saving, and how much of it was the direct result of greater volume of traffic.

For example, the fixed costs, i.e., those that remain static insofar as volume of traffic is concerned, of a given railroad are appraised as 207.6 million rubles and the variable costs are estimated as 245 million rubles. In this calculation the variable costs include maintenance of locomotives, maintenance and annual overhaul of railroad cars and depreciation of amortization of equipment.

The total costs which would result from increased volume of traffic on this railroad are about 59.7 million rubles. These costs show up in running expenses; however, there will be no change, regardless of increased or decreased traffic, in the cost of amortization (amount will be the same as in the plan) or in the cost of the fixed and invariable program of maintenance of rolling stock. Therefore, in the annual financial report of the railroad, amortization and maintenance are treated as fixed costs rather than as dependent on volume. After this adjustment, the amount of fixed costs increases to 267.3 million rubles (59.7 percent of the total cost), and the variable costs decrease to 185.3 million rubles (40.9 percent of total cost). As the result of increased traffic, the variable costs increase as follows:

$$\frac{185.3 \times 9{,}600}{8{,}800} = 202 \text{ million rubles}$$

Thus, calculated on the basis of planned cost per ton-kilometer, the actual cost of the increased volume of traffic (with observance of all quality indexes) amounted to only 469.3 million rubles, and, other conditions remaining unchanged, there was an actual saving of 24.7 million rubles.

In evaluating the influence of plan fulfillment on costs, it is necessary to analyze the conditions under which transport was effected. Of prime importance is the freight-car park available to the railroad. It is necessary to scrutinize the achievements of a railroad which exceeded the plan for freight-car turnaround time, or which exceeded the plan for collecting surplus rolling stock, without speeding up the freight-car turnaround time.

After determining the amount by which the running expenses increased because of greater volume, it would be expedient to ascertain what influence on the amount of operational costs was exerted by the fulfillment of qualitative indexes, such as utilization of transportation equipment load per axle, proportion of empties, gross weight of train, percentage of auxiliary trips of locomotives, etc.

Utilization of transportation equipment and its influence on actual costs vary with the technical equipment of the track, density of traffic, number of stations and junctions, power of locomotives, and climatic conditions. However, as there is little variation among the different railroads operating, the following formula may be used throughout the railroad net.

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Variations in Costs
(in percent, when absolute indexes of rolling-stock utilization vary one percent)

Indexes	Total Costs	Freight Costs	Passenger-Traffic Costs
Dynamic weight per freight-car axle	--	0.23	--
Percentage of empties carried, as compared with loaded cars	--	0.09	--
Gross weight of freight train	--	0.25	--
Percentage of auxiliary locomotive travel	0.20	--	--
Number of passengers per axle	--	--	0.40
Passenger trains made up	--	--	0.20

Other traffic conditions will also be reflected in cost calculations. For example, if the labor cost of freight-train personnel has been budgeted as 5,280,000 rubles for a gross train weight of 1,310 tons and the actual gross weight was 1,350 tons, the following formula will express the true ratio:

$$\frac{5,280 \times 1,310}{1,350} = 5,120,000 \text{ rubles}$$

Thus, the increased gross weight of trains has decreased the actual cost of operation by 160,000 rubles.

An important influence on costs is a change in norms for labor, materials, fuel, and electric power, in the case of a transportation unit as well as of permanent installations.

The following form will be useful in making further analyses:

Indexes	Unit	Actual Costs Present Period	Planned Cost	Actual Costs Preceding Period	Plan Fulfillment	Current ± in Percent of Prior Period
1. Volume of traffic ton-km	Million		/columns blank in original/			
2. Total costs	Million rubles					
a. Wage fund with increases	" "					
dependent on number of people employed	Persons					
dependent on average monthly wage	Rubles					
b. Fuel for locomotives per 10,000 gross ton-km	Kg					
c. Electric motive power for trains	Million rubles					
Cost per kw-hr	Kopecks					
Gross ton-km	Million					
d. Average cost of repairs of transportation units	Million rubles					
Locomotives	" "					
Freight cars	" "					
Amortization	" "					
3. Actual cost of ton-km traveled	Kopecks					
4. Ton-km traveled per worker	Thousands					
5. Length of line traveled	Km					

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On the basis of the preceding table, it is possible to determine exactly which class of costs was responsible for the increase or decrease in actual expenditures.

In analyzing the wage fund, it is necessary to study the fulfillment of the productivity plan, as determined by the number of ton-kilometers traveled per employee. In railroad costs, the cost of labor is an important factor, as labor productivity influences costs mainly because labor costs, for both blue- and white-collar workers, are proportionately lowered as productivity increases. Productivity in railroad transport has tripled since the October Revolution.

The productivity of workers in various categories is measured by different indexes. For example, the productivity of a train crew would be judged by the relative number of train-kilometers traveled per crew; productivity of the engine crew, by the number of kilometers traveled by the locomotives; of car-maintenance repair crews, by the number of man-hours per 1,000 kilometers traveled by the cars; of repair men doing maintenance work on trains, by the number of man-hours per 1,000 kilometers traveled by the car, etc.

In analyzing productivity, special attention should be paid to Stakhanovite work methods, improved efficiency in utilization of the transport park, increase in performance norms and technicoeconomic norms, more efficient use of machines and equipment, etc.

In analyzing materials used in repairs, it is necessary to differentiate between those used for maintenance, for major repairs, or for replacement of equipment damaged by accidents, carelessness, etc.

In the transport service the basic index for measurement of efficiency is the train-kilometer. The number of trains determines the cost ratio for wages of train crews and lighting of train signals. The "time-assembly" index determines the cost of personnel employed in the yards classifying trains.

In the locomotive branch the number of gross ton-kilometers traveled determines the cost ratio of fuel used for mechanics' wages, maintenance, and greasing of locomotives.

In the car service the basic index is the car-axle-kilometer ratio and also the train-kilometer. The former determines the cost ratio for maintenance, greasing, and servicing of cars; the latter determines the wages paid to crews.

In analyzing freight-car costs, the turnaround time on the individual railroad only is considered, while the turnaround time of passenger cars is calculated on all railroads of the net. In passenger traffic the basic index is the axle-kilometers of the cars. Upon the cost ratio depend the wages of all passenger train crews, as well as of service and cleaning personnel.

The analysis of electrified roads and trains follows the same basic pattern as that set for nonelectric trains.

A sample analysis of fuels and loads of locomotives per 10,000 gross ton-kilometers follows

	Planned	Actual
Gross ton-kilometers (in millions)		
Freight and other revenue traffic	2,800	3,090
Passenger traffic	700	730
Total	3,500	3,820

	Planned	Actual
Locomotive-kilometers (in thousands)		
Freight trains	2,000	2,100
Passenger trains	1,000	1,100
One-/way?/ trip	200	199
Classification with yard locomotives	400	401
Other movements	300	299
Total	4,000	4,149
Use of fuel per 10,000 gross ton-kilometers in freight and passenger traffic		
Use of fuel, freight and passenger (kg)	250	
Use of fuel, freight only (kg)	229	
Use of fuel, passenger only (kg)	275	
Fuel use per 100 locomotive-km, one-trip (tons)		0.8
Fuel use per 100 locomotive-km, in classification (tons)	1.2	
Fuel use per hour of idle time, locomotives with steam up (kg)		38
Gross weight of freight train (tons)	1,400	1,470
Track length (km)	100	100

In this example, the actual average temperature for the year was 3 degrees centigrade, whereas the plan assumed 5 degrees mean temperature. The fuel used for locomotives contained 0.6 percent less ash than planned. In the year mentioned there were 4,000 instances of lowered travel speed due to defective track and 300 unscheduled stops.

The formulas which follow show the effect of individual factors.

1. Gross weight of trains as planned was 1,400 tons and actual weight was 1,470 tons. Hence: $\frac{1,470 - 1,400}{1,400} \times 100 = 5$ percent

Since every one-percent increase in train weight lowers the fuel-consumption ratio by 0.4 percent, $5 \times 0.4 = 2$ percent

The specific weight of ton-kilometers traveled in freight and other revenue traffic is $\frac{3,090}{3,820} \times 100 = 81$ percent

The ratio expressing fuel cost in both classes of traffic is lowered as follows: $\frac{250 \times 2 \times 0.81}{100} = 4$ kilograms

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2. Turnaround time of locomotives in freight traffic was below the plan by 20 - 18.5 or 1.5 hours. Since the number of locomotives is $\frac{2,100,000-199,000}{200} =$ 11,500, the saving is 1.5 x 11,500, or 17,300 hours.

Since the cost of idle time is 38 kilograms per hour, the saving in fuel costs may be expressed as $\frac{38 \times 17,300}{1,000} = 658$ tons, or, per 10,000 gross ton-kilometers, $\frac{658,000 \times 10,000}{3,820,000,000} = 1.7$ kilograms.

3. The movement of empties has been decreased by 3 percent. Since one percent of this decrease results in an approximate fuel saving of 0.25 percent, the formula is 0.25 x 3 = 0.75 percent. However, in both kinds of traffic the lowered fuel consumption is 0.75 x 0.81 = 0.61 percent or $\frac{250 \times 0.61}{100} = 1.5$ kilograms.

4. The effects of decreased yard work (classification, etc.) are computed as follows.

The plan calls for $\frac{400,000}{3,500} = 114$ kilometers of yard work per million ton-kilometers, or a total of 114 x 3,820 = 435,000 locomotive-kilometers. Actually, only 401,000 locomotive-kilometers were necessary; therefore, 435,000 - 401,000 = 34,000 kilometers. Since 1.2 tons of fuel are necessary for each 100 kilometers, the resultant economy amounts to $1.2 \times \frac{34,000}{100} = 408$ tons of fuel per 10,000 gross ton kilometers; and $\frac{408,000 \times 10,000}{3,820,000,000} = 1.1$ kilograms.

5. The norm as set in the plan for locomotives in one-way travel is $\frac{200,000}{3,500} = 57.2$ locomotive kilometers per million gross ton-kilometers. Therefore, 3,820 gross ton-kilometers would require $\frac{57.2 \times 3,820,000,000}{1,000,000} = 218,000$ kilometers, and the saving effected is 218,000 - 199,000 = 19,000 kilometers, which decreases the cost of fuel by $\frac{0.8 \times 19,000}{100} = 152$ tons, or, for 10,000 gross ton-kilometers, $\frac{152,000 \times 10,000}{3,820,000,000} = 0.4$ kilogram.

6. Planned passenger traffic amounts to $\frac{70,000}{3,500} = 20$ percent [of all rail traffic]. Actual passenger traffic was $\frac{730,100}{3,280} = 19$ percent or a saving of one percent.

The normal consumption of fuel for passenger traffic is higher than for freight traffic, that is, $\frac{275}{229} = 1.2$, or 20 percent higher. Decreasing the proportion of passenger traffic therefore lowers fuel consumption as follows: 0.01 x 20 = 0.2 percent or .002 x 250 = 0.5 kilogram.

7. Since a change of one degree centigrade in mean temperature affects use of fuel by 0.8 percent, a lowered mean temperature of 1.5 degrees centigrade increases fuel consumption thus: 1.5 x 0.8 = 1.2 percent, or $\frac{250 \times 1.2}{100} =$ 3 kilogram.

8. Under average conditions each train stop causes additional consumption of 65 kilograms of fuel, and each instance of reduced train speed an additional fuel cost of 53 kilograms; therefore, 300 stops and 4,000 instances of reduced speed result in extra consumption of 65 x 300 + 53 x 400 = 231.5 tons of fuel, or $\frac{2,315,000 \times 10,000}{3,820,000,000}$ = 0.6 [sic] kilogram per 10,000 gross ton kilometers.

9. A one percent increase in volume of traffic with series-FD locomotives increases the normal fuel-consumption ratio by 0.2 percent as compared with series-E locomotives; whereas a one-percent increase in traffic with series SO results in a decrease in the fuel-consumption ratio of 0.05 percent. Therefore, a 3-percent increase in traffic with series FD and a 2-percent increase with series SO will increase fuel consumption for freight traffic by 3 x 0.2 - 2 x 0.05 = 0.5 percent, and on the basis of 10,000 gross ton-kilometers for both freight and passenger transport, by $\frac{0.5 \times 81}{100}$ = 0.4 percent, or $\frac{250 \times 0.4}{100}$ = 1 kilogram.

10. Since in locomotives equipped with a water heater the fuel-consumption ratio decreases by 3 percent when the workload is increased by one percent, the modernization of locomotives results in a saving of 3 x 0.01 = 0.03 percent or $\frac{250 \times 0.03}{100}$ = 0.1 kilogram.

11. As a one-percent decrease of ash content lowers fuel consumption by 0.5 percent, an actual 0.6-percent decrease results in a saving of fuel of 0.5 x 0.6 = 0.3 percent, or $\frac{250 \times 0.3}{100}$ = 0.8 kilogram, or for 10,000 gross ton-kilometers, 4 + 1.7 + 1.5 + 1.1 + 0.4 + 0.5 - 3 - 0.6 - 1.0 + 0.1 + 0.8 = 5.5 kilograms.

Appraisal of activity cannot be based only on comparison between actual and planned costs, since cost reductions do not show the quality of service performed nor reflect any improvements. For example, in freight traffic, operating cost per train-kilometer may be decreased by 3 percent as compared with planned cost, while at the same time there is a 5-percent reduction in freight-train weights. This means that if the freight traffic plan is fulfilled 100 percent (in ton-kilometers), performance is unsatisfactory, since the freight-train turnaround time (because freight-train weights were less than planned) increased in the ratio of 1 : 0.95 = 1.053 times, and the fuel consumption per ton-kilometer increased 97 x 1.053 = 102.1 percent. Hence, the net increase in comparison with planned costs is 2.1 percent

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